S4-O.04

Coupling of cropping system models with the AEGIS platform

Auzoux Sandrine[1] (sandrine.auzoux@cirad.fr), Christina Mathias[1], Ripoche Aude[2], Soulié Jean-Christophe[3]

[1] *AIDA, CIRAD, Saint Denis, Réunion*; [2] *AIDA, CIRAD, Antsirabe, Madagascar*; [3] *Recycling and Risk, CIRAD, Saint Denis, Réunion*

Introduction

Agroecological studies dealing with genotype by environment by management interactions generate heterogeneous datasets difficult to gather, store, share and analyse. Modelling is an essential tool for designing and evaluating innovative sustainable cropping systems. Data integration, sharing and reusing for crop modelling need a good data management. CIRAD has developed the AEGIS (AgroEcological Global Information System) platform, which aims to sustain the data value chain (Curry, 2015) for agroecological studies. This paper present the platform overall organisation and the approach used to ensure the data–model continuum.

Materials and Methods

Good data management is based on two key principles. The first is Data Lifecycle Management (DLM), which consists of managing data throughout its life cycle from production to use. The second is the FAIR data principles that aim to make data findable, freely accessible, interoperable and increase data reuse. Compliant with these standards, the AEGIS platform is organized into four pilars that focus on the steps of data acquisition, processing, sharing and enhancement. Data acquisition is a process of gathering, describing and harmonizing data. AEGIS integrates a generic ®ECOFI database (Auzoux *et al.*, 2017) using metadata technology that allows any type of data to be easily imported according to a collection process and uses a variable dictionary to facilitate the annotation of data making them understandable to all. Data processing is about making the raw data acquired easily usable for analysis and modelling. Through integrated dashboards, AEGIS offers a real-time overview of all stored data, ranging from raw data to indicators for assessing the sustainability and performance of agroecosystems. It provides homogeneous datasets for crops models simulations and capitalizes processed data, which can be simulation parameters and outputs, analysis results and performance indicators. AEGIS proposes data visualisation tools that highlight patterns and correlations inaccessible from the raw data. In the context of open data, AEGIS ensures data sharing increasing the impact and visibility of agroecological studies, promoting potential data reuse for modelling. Interoperability is considered as a necessity for data sharing and involves four levels of data exchange: system, syntactic, structural and semantic. AEGIS uses ontologies dedicated to the plant, pest, environment and cultural practices to ensure compatibility with data from other platforms that comply with these ontologies. Datasets provided comply with metadata standards such as Darwin Core, MIAPPE and EML. AEGIS is able to export data using the standard open Breeding Application Programming Interface (BrAPI). By ensuring data standardization, optimization and curation, AEGIS enhance data in term of publishing quality, accuracy in decision-making and financial value creation.

Results and Discussion

Such coupling of cropping system models allows performing three kinds of fundamental works in the present agroecological studies: (i) model validation, (ii) parameters estimation, and (iii) cropping system models comparison. In the first work (Chaput et. al 2019), that aims to test the ability of a crop growth model (STICS) to simulate the sugarcane growth response to different climates, soils and nitrogen management. The STICS model was calibrated using the observed data provided by AEGIS that illustrates more than 10 years of sugarcane trials in Réunion. In the second work (Christina et. al, 2019) that aims to model the annual variability of sugar cane yield in Reunion Island, AEGIS is the scheduler of the estimation process until the RMSE error is minimized. It asks to a simulated annealing algorithm to generate a new set of input parameters. These parameters are used to set up simulations of cane growth MOSICAS model thanks to the generic ®ECOFI database and output variables are compared to observed values stored within AEGIS. In the third work, that aims to study on sugarcane dealing with genotype, environment and management interactions as part of the "International Consortium for Sugarcane Modelling" (ICSM), AEGIS has been used to setup, launch simulations of STICS, MOSICAS, and DSSAT models, and compare simulations regarding observed values stored within AEGIS.

.../...

Conclusions

AEGIS is a platform that participates in the construction of a data repository characterizing agroecosystems for integrated multi-scale analysis and ensures data consistency through harmonized reference systems and procedures. It provides all the features of the data value chain paradigm. It ensures a formal coupling (parametrization and output analyse) with the most well-known and ad hoc cropping systems models. It has been used in European and international projects involved in the agro-ecological transition as a steering and decision-making tool.

Keywords: Data integration, Data value chain, Interoperability, Crop modelling, Database.

References:

1. Auzoux S, Martiné JF, Loison R, Poser C, Marnotte P, Goebel FR (2017) ECOFI: A new generic database to analyze complex agroecological experimentation. International Sugar Journal, 119 (1419): 214-218.
2. Chaput M, Christina M, Versini A, Février A and Soulié JC (2019) Modelling the impact of soil and climatic variability on sugarcane growth response to mineral and organic fertilisers. In: Proceedings of the International Society of Sugar Cane Technologists, volume 30, 250–252.
3. Christina M, Le Mezo L, Mezino M, Barau L, Tendero A, Auzoux S and Todoroff P (2019) Modelling the annual yield variability in sugarcane in Réunion. In: Proceedings of the International Society of Sugar Cane Technologists, volume 30, 393–401.
4. Curry E. 2016. The Big Data Value Chain: Definitions, Concepts, and Theoretical Approaches. In: New Horizons for a Data-Driven Economy. Springer International Publishing, 29-37. https://doi.org/10.1007/978-3-319-21569-3_3.